FILE 'INPADOC, WPIX, JAPIO, HCAPLUS' ENTERED AT 10:50:23 ON 28 OCT 2002

```
L1        6 S  JP2000-0245626/PRN,AP
               SET SMARTSELECT ON;L2       SEL L1 1- IC RN :    23 TERMS
L3   349051 S  L2
L4        6 S  L1 AND L3
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FILE 'SCISEARCH' ENTERED AT 10:59:50 ON 28 OCT 2002

```
L5       38 S  LIGHT EMITTING DIODES/TI AND BASED/TI AND GAN/TI
L6        1 S  L5 AND 237/SO
L7       51 S  ("BOULOU M, 1977, V37, P237, PHILLIPS TECH REV"/RE OR . . . . )
L8        0 S  L7 AND ROTAT#######
L9        0 S  L7 AND TILT####
L10       1 S  L7 AND ANGL###
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FILE 'WPIX, JAPIO, HCAPLUS, INSPEC, INSPHYS, CEABA-VTB, JICST-EPLUS, PASCAL, SCISEARCH, CONFSCI' ENTERED AT 11:04:57 ON 28 OCT 2002

```
L11    1552 S  0110
L12   22330 S  (HETEROEPITAX? OR HETERO EPITAX########)
L13  409821 S  EPITAX######
```

FILE 'REGISTRY' ENTERED AT 11:07:42 ON 28 OCT 2002

```
L14       3 S  (SAPPHIRE/CN OR "SAPPHIRE (AL2O3)"/CN OR "SAPPHIRE EMB"/CN OR "SAPPHIRE II"/CN)
L15       1 S  CORUNDUM/CN
```

FILE 'WPIX, JAPIO, HCAPLUS, INSPEC, INSPHYS, CEABA-VTB, JICST-EPLUS, PASCAL, SCISEARCH, CONFSCI' ENTERED AT 11:11:49 ON 28 OCT 2002

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L16   20499 S  (1302-74-5 OR CORUNDUM OR SAPPHIRE OR LEUCOSAPPHIRE OR 1317-82-4)(2A)(BASE OR SUBSTRATE)
L17   28104 S  (1302-74-5 OR CORUNDUM OR SAPPHIRE OR LEUCOSAPPHIRE OR 1317-82-4)(L)(BASE OR SUBSTRATE)
L18   28104 S  (L16 OR L17)
L19       4 S  01BAR10 OR 011BAR0 OR 01 BAR 10 OR 01 BAR10 OR 011BAR 0 OR 011 BAR0 OR 011 BAR 0
L20   22457 S  ALPHA(4A)(SAPPHIRE OR LEUCOSAPPHIRE OR CORUNDUM OR AL2O3 OR ALUMINIUM OXIDE OR ALUMINIUM OXIDE)
L21   23987 S  L11 OR (L19 OR L20)
L22    1410 S  L21 AND (L12 OR L13)
L23     496 S  L18 AND L22
L24       5 S  L23 AND TILT#####
L25      43 S  L23 AND ROTAT#######
L26      25 S  L23 AND ANGL###
L27       8 S  L12 AND (L25 OR L26)
L28      13 S  L24 OR L27
L29       9 DUP REM L28 (4 DUPLICATES REMOVED)
L30   48141 S  (1344-28-1 OR ALUMINA)(L)(BASE OR SUBSTRATE )
L31       1 S  L25 AND L26
L32     131 S  L30 AND L12
L33       2 S  L32 AND TILT####
L34       2 S  L33 NOT L28
L35   17882 S  (1344-28-1 OR ALUMINA)(3A)(BASE OR  SUBSTRATE)
L36      24 S  L35 AND TILT####
L37      24 S  L36 NOT L28
L38      24 S  L34 OR L37
L39      24 DUP REM L38 (0 DUPLICATES REMOVED)
L40      10 S  L39 AND (ANGL### OR ROTAT#####)
L41       5 S  L35 AND (ANGL### AND ROTAT#####)
L42      16 S  (L34 OR (L40 OR L41)) NOT (L28 OR L31)
L43      16 DUP REM L42 (0 DUPLICATES REMOVED)
L44       6 S  (L12 OR L13) AND L43
L45    1859 S  (L18 OR L20 OR L11 OR L30 OR L35) AND  HEXAGON######
L46     836 S  L45 AND (L12 OR L13)
L47      18 S  L46 AND TILT#### AND (ROTAT######## OR  ANGL####)
L48      14 S  L28 OR L31
L49      20 S  (L28 OR L31 OR L44)
L50      16 S  L47 NOT L49
L51       6 DUP REM L50 (10 DUPLICATES REMOVED)
L52   32851 S  VPE OR MOVPE OR OMVPE
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FILE 'WPIX, JAPIO, HCAPLUS, INSPEC, INSPHYS, CEABA-VTB, JICST-EPLUS, PASCAL, SCISEARCH, CONFSCI' ENTERED AT 11:11:49 ON 28 OCT 2002

L53 112 S M FACE
L54 142 S M(W)(FACE OR FACED OR FACING)
L55 1697 S L11 OR L19 OR L54
L56 2267 S L55 OR M(W) PLANE##
L57 157 S L56 AND (L12 OR L13)
L58 11 S L57 AND TILT##### AND (ROTAT##### OR ANGL###)
L59 10 S L56 AND L52
L60 4 S L57 AND (ROTAT##### AND ANGL###)
L61 18 S (L58 OR L59 OR L60)
L62 36 S (L49 OR L50)
L63 17 S L61 NOT L62
L64 11 DUP REM L63 (6 DUPLICATES REMOVED)
L65 2029 S 10 HIVIN 10
L66 419603 S (L12 OR L13) OR L52
L67 214 S L65 AND L66
L68 18 S L67 AND (L12 OR HETERO)
L69 53 S (L62 OR L63)
L70 16 S L68 NOT L69
L71 16 DUP REM L70 (0 DUPLICATES REMOVED)
L72 1 S L67 AND TILT#### AND (ROTAT######## OR ANGL#####)
L73 1 S L67 AND (ROTAT######## AND ANGL#####)
L74 94 S L67 AND (DEG OR DEGREE)
L75 76 S L74 AND (ORIENT###### OR ANGL### OR TILT###### OR ROTAT########)
L76 96483 S (L18 OR L20 OR L11 OR L30 OR L35)
L77 36 S L75 AND L76
L78 70 S L69 OR L70 OR L71 OR L72
L79 27 S L77 NOT L78
L80 27 DUP REM L79 (0 DUPLICATES REMOVED)
L81 16869 S MISORIENT######### OR MIS ORIENT########
L82 4289 S L56 OR L65
L83 57 S L81 AND L82
L84 97 S L78 OR L79
L85 51 S L83 NOT L84
L86 36 DUP REM L85 (15 DUPLICATES REMOVED)
L87 13 S L76 AND L86
L88 83058 S C(W)(PLAN### OR AXIS)
L89 82 S L82 AND L88 AND L76
L90 110 S L84 OR L87
L91 51 DUP REM L89 (31 DUPLICATES REMOVED)
L92 39 S L91 NOT L90
L93 0 S L12 AND L92
L94 1577 S (IN AND GA AND AL AND N)/CHI
L95 0 S AL.GA.IN.N/MF

FILE 'REGISTRY' ENTERED AT 12:06:00 ON 28 OCT 2002

L96 169 S AL.GA.IN.N/MF
L97 168 S AL GA IN N/ELF
L98 169 S L96 OR L97

FILE 'WPIX, JAPIO, HCAPLUS, INSPEC, INSPHYS, CEABA-VTB, JICST-EPLUS, PASCAL, SCISEARCH, CONFSCI' ENTERED AT 12:07:15 ON 28 OCT 2002

L99 0 S L92 AND (L94 OR L98)
L100 1577 S L94
L101 823 S L98
L102 2400 S L100 OR L101
L103 0 S L92 AND L102
L104 19 S L92 AND NITRIDE
L105 20342 S WITHOUT(2A)(ANGL#### OR ROTAT####### OR REVOL########)
L106 1 S L82 AND L105

ANSWER 1 HCAPLUS COPYRIGHT 2002 ACS
AN 1997:405245 HCAPLUS
DN 127:111870
TI Orientation relationships in heteroepitaxial aluminum films on sapphire
AU Medlin, D. L.; McCarty, K. F.; Hwang, R. Q.; Guthrie, S. E.; Baskes, M. I.
CS Sandia National Laboratories, Livermore, CA, 94551, USA
SO Thin Solid Films (1997), 299(1-2), 110-114
CODEN: THSFAP; ISSN: 0040-6090
PB Elsevier
DT Journal
LA English
CC 56-6 (Nonferrous Metals and Alloys)
Section cross-reference(s): 75
AB The microstructure and orientation relationships were examd. in aluminum thin films deposited epitaxially on sapphire (0001). The films consist of grains with three distinct types of orientation relative to the substrate. The primary orientation is such that (0001)Al2O3.dblvert.(111)Al and [10.hivin.10]Al2O3.dblvert.[.hivin.110]Al. This configuration, which matches the close-packed planes and directions of the metal film with those of the oxygen ion sublattice in the sapphire substrate, allows for growth of two sym. equiv. orientation variants resulting in a film composed of interlocking regions of these two domains. Unexpectedly, two addnl. orientation types are identified in the films. As in the primary variant, the close-packed aluminum {111} planes remain parallel with the sapphire basal planes. However, these orientations are rotated about the aluminum [111] axis such that [10.hivin.10]Al2O3 is parallel to directions near either [.hivin.12.hivin.1]Al (30.degree. rotation) or [5.hivin.4.hivin.1]Al (.apprx.11.degree. rotation).
ST aluminum heteroepitaxial film sapphire crystal orientation
IT Crystal orientation
(in heteroepitaxial aluminum films on sapphire)

L87 ANSWER 9 OF 13 INSPEC
AN 1997:5581073 INSPEC DN A9712-8115H-050; B9706-0510D-120
TI The effect of **substrate misorientation** on the optical, structural, and electrical properties of GaN grown on **sapphire** by MOCVD.
AU Grudowski, P.A.; Holmes, A.L.; Eiting, C.J.; Dupuis, R.D. (Microelectron. Res. Center, Texas Univ., Austin, TX, USA)
SO Journal of Electronic Materials (March 1997) vol.26, no.3, p.257-61. 10 refs.
Published by: TMS
CODEN: JECMA5 ISSN: 0361-5235
SICI: 0361-5235(199703)26:3L.257:ESMO;1-#
Conference: Proceedings of the 38th Electronic Materials Conference. Santa Barbara, CA, USA, 26-28 June 1996
DT Conference Article; Journal
TC Experimental
CY United States
LA English
AB We report the growth and characterization of unintentionally doped GaN on both exact and vicinal (0001) **sapphire substrates**. The GaN heteroepitaxial layers are grown by metalorganic chemical vapor deposition on c-plane Al2O3 **substrates** either on-axis or intentionally **misoriented** 2 degrees toward the alpha -plane (1120) or 5 or 9 degrees toward the **m-plane** (1010). The samples are characterized by 300 K photoluminescence, cathodoluminescence, and Hall-effect measurements as well as by triple-axis X-ray diffractometry to determine the effect of the **misorientation** on the optical, electrical, and structural properties of heteroepitaxial undoped GaN. Ten different sample sets are studied. The data reveal enhanced photoluminescence properties, increased electron mobility, a reduced n-type background carrier concentration, and a somewhat degraded surface morphology and crystalline quality for the **misoriented** samples compared to the on-axis samples.

L87 ANSWER 6 OF 13 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:741514 HCAPLUS
DN 126:124187
TI The effect of **substrate misorientation** on the photoluminescence properties of GaN grown on **sapphire** by metalorganic chemical vapor deposition
AU Grudowski, P. A.; Holmes, A. L.; Eiting, C. J.; Dupuis, R. D.
CS Microelectronics Research Center, Univ. Texas Austin, Austin, TX, 78712-1100, USA
SO Applied Physics Letters (1996), 69(24), 3626-3628
CODEN: APPLAB; ISSN: 0003-6951
PB American Institute of Physics
DT Journal
LA English
CC 73-5 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
AB The authors report the growth and photoluminescence (300 and 4.2 K) characterization of unintentionally doped GaN on both exact and vicinal (0001) **sapphire substrates**. The GaN heteroepitaxial layers are grown by metalorg. CVD on **sapphire substrates** using various growth conditions. The (0001) Al2O3 c-plane **substrates** are oriented exactly (0001) or **misoriented** either 2.degree. towards the a plane (1120), 5.degree. towards the **m plane** (1010), or 9.degree. toward the **m plane**. A comparison of the 300 and 4.2 K optical characteristics of the samples grown on the different **substrates** indicates that a higher photoluminescence intensity is measured for the films on **misoriented substrates**.

L87 ANSWER 4 OF 13 HCAPLUS COPYRIGHT 2002 ACS
AN 1999:266405 HCAPLUS
DN 131:94176
TI GaN epilayers on **misoriented** substrates
AU Trager-Cowan, C.; McArthur, S.; Middleton, P. G.; O'Donnell, K. P.; Zubia, D.; Hersee, S. D.
CS Department of Physics and Applied Physics, University of Strathclyde, Glasgow, G4 0NG, UK
SO Materials Science & Engineering, B: Solid-State Materials for Advanced Technology (1999), B59(1-3), 235-238
CODEN: MSBTEK; ISSN: 0921-5107
PB Elsevier Science S.A.
DT Journal
LA English
CC 73-5 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 75
AB Three Si-doped 3 .mu.m thick GaN epilayers were grown simultaneously by metalorg. CVD on (0001) **sapphire substrates misoriented** by 0, 4 and 10.degree. toward the **m-plane** (1010). A comparative study of these epilayers was undertaken using photoluminescence (PL) spectroscopy, at. force microscopy (AFM) SEM, cathodoluminescence (CL) imaging and CL spectroscopy. Low temp. PL of the 0 and 4.degree. epilayers shows bound exciton (BE) emission between 3.47 and 3.48 eV and a low level of yellow band emission. The peak intensities of both emission bands are a factor of 2 higher for the 4.degree. layer. In the 10.degree. epilayer, the BE band is 3.times. stronger than in the 0o epilayer but there is no discernible yellow band. However, a no. of addnl. bands appear at 3.459, 3.417, 3.362, 3.345, 3.309 and 3.285 eV. These bands may be attributed to the presence of structural defects in this epilayer, pointing to an abrupt degrdn. of its structural quality compared to the others. This degrdn. is confirmed by AFM studies. On a 20.times.20 .mu.m2 image the 0 and 4.degree. epilayers exhibit smooth surface morphologies, while the 10.degree. epilayer shows a high d. of hexagonal pits. Finally, SEM images reveal the surface of the 10.degree. epilayer to be 'streaked' and pitted. Low temp. CL images at 3.48 eV (bound exciton region) show random spotty emission, while those at 3.28 eV and 3.41 eV exhibit a streaky appearance similar to the SEM image. Probably these luminescence bands are indeed assocd. with structural defects.

L6 ANSWER 8 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:730659 HCAPLUS
DN 126:53355
TI Substrates for epitaxial growth of InGaAlN system
AU Matsuoka, Takashi
CS NTT Opto-electronics Lab., Atsugi, 243-01, Japan
SO Nippon Kessho Seicho Gakkaishi (1996), 23(4), 345-353
CODEN: NKSGDK; ISSN: 0385-6275
PB Nippon Kessho Seicho Gakkai
DT Journal
LA Japanese
AB The properties of substrate lattice-matching to InGaAlN, which has progressed in light emitting devices in the wavelength shorter than that of green light, and high-power transport devices operated at high temp., are described. The lattice const., crystal structure, cleavability and its direction of substrates is explained in comparison with InGaAlN. Of the sapphire substrates widely used at present, the **(01. hivin.10)** plane is shown to be the most suitable substrate com. available. The GaN growth on a (001) 6H-SiC substrate with polarity is introduced and the substrate polarity is described to severely affect the cryst. quality of an epitaxially grown film. This paper also reviews (101) NdGaO3 and (111) MgAl2O4 as substrates nearly lattice-matched to GaN. The In0.22Ga0.78N on a house-made (001) ZnO substrate is reported as the only attempt of lattice-matching growth in InGaAlN.
IT **1317-82-4**, Sapphire

L87 ANSWER 3 OF 13 HCAPLUS COPYRIGHT 2002 ACS
AN 2000:373380 HCAPLUS
DN 133:10711
TI Probing nitride thin films in 3-dimensions using a variable energy electron beam
AU Trager-Cowan, Carol; McColl, D.; Sweeney, F.; Grimson, S. T. F.; Treguer, J-F.; Mohammed, A.; Middleton, P. G.; Manson-Smith, S. K.; O'Donnell, K. P.; Van der Stricht, W.; Moerman, I.; Demeester, P.; Wu, M. F.; Vantomme, A.; Zubia, D.; Hersee, S. D.
CS Dept. Physics and Applied Physics, University of Strathclyde, Glasgow, G4 0NG, UK
SO Materials Research Society Symposium Proceedings (2000), 595(GaN and Related Alloys--1999), W5.10.1-W5.10.6
CODEN: MRSPDH; ISSN: 0272-9172
PB Materials Research Society
DT Journal
LA English
CC 73-10 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
AB The authors illustrate the application of electron beam techniques to the measurement of strain, defect and alloy concns. in nitride thin films. The authors present brief comparative studies of CL spectra of AlGaN and InGaN epilayers and EBSD patterns obtained from 2 Si-doped 3 .mu.m thick GaN epilayers grown on an on-axis (0001) **sapphire substrate** and a **sapphire substrate misoriented** by 10.degree. toward the **m-plane** (1010).

L104 ANSWER 3 OF 19 JAPIO COPYRIGHT 2002 JPO
AN 1999-004048 JAPIO
TI **NITRIDE** SEMICONDUCTOR DEVICE AND MANUFACTURE THEREOF
IN SUGIMOTO YASUNOBU; KIYOHISA HIROYUKI; OZAKI NORIYA; IWASA SHIGETO; NAKAMURA SHUJI
PA NICHIA CHEM IND LTD
PI JP 11004048 A 19990106 Heisei
AI JP 1998-50859 (JP10050859 Heisei) 19980303
PRAI JP 1997-99494 19970417
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1999
IC ICM H01S003-18
ICS H01L021-301; H01L031-10; H01L033-00

AB PROBLEM TO BE SOLVED: To enable a laser device possessed of a **nitride** semiconductor **substrate** and its resonant plane to be formed by a method wherein the opposed edge faces of an active layer of the **nitride** semiconductor device are set flush with the cleavage plane of a **nitride** semiconductor **substrate** M piane (11-00).
SOLUTION: A protective film formed like a stripe vertical to the A plane (112-0) of a **sapphire substrate** is provided onto the **sapphire substrate** whose main surface is a **C plane** (0001). Or, a protective film formed like a stripe vertical to the R plane (11 02) of a **sapphire substrate** is provided onto the **sapphire substrate** whose main surface is a A plane (112-0). A **nitride** semiconductor is grown on the protective film for the formation of a **nitride** semiconductor **substrate**. Furthermore, a **nitride** semiconductor layer which includes an active layer is formed on the **nitride** semiconductor **substrate**, the **sapphire substrate** is removed from the **nitride** semiconductor **substrate**, and then the cleavage plane of the **M plane** (11-00) of the **nitride** semiconductor **substrate** is set flush with the edge face of the active layer.

L104 ANSWER 4 OF 19 JAPIO COPYRIGHT 2002 JPO
AN 1998-190149 JAPIO
TI MANUFACTURE OF **NITRIDE** SEMICONDUCTOR LASER ELEMENT
IN SUGIMOTO YASUNOBU; NAKAMURA SHUJI
PA NICHIA CHEM IND LTD
PI JP 10190149 A 19980721 Heisei
AI JP 1996-349418 (JP08349418 Heisei) 19961227
PRAI JP 1996-349418 19961227
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1998
IC ICM H01S003-18
ICS H01L033-00

AB PROBLEM TO BE SOLVED: To provide a laser beam having the shape of an elliptic poor field pattern by forming resonant surfaces by etching a **nitride** semiconductor layer on a **sapphire substrate** having a main surface composed of the **C-plane** of **sapphire** and dividing the **sapphire substrate** between the facing resonant surfaces.
SOLUTION: Resonant surfaces are formed on the end faces of an active layer by etching an n-type **nitride** semiconductor layer 2 on a **sapphire substrate** 1 having a main surface composed of the **C-plane** of **sapphire** so that the resonant surface of one laser element is oppositely faced to that of the other resonant surface. Then the **sapphire substrate** 1 between the facing resonant surfaces is divided into parts along the A- or **M-plane** of **sapphire**. In addition, part of the **substrate** 1 containing the projecting part from the resonant surface is prevented from interrupting the laser beam emitted from the resonant surface by setting one dividing position near one resonant surface so that the projecting section will not interrupt the laser beam.

ANSWER 1 HCAPLUS COPYRIGHT 2002 ACS
AN 1998:108727 HCAPLUS
DN 128:220180
TI Growth and structure of internal Cu/Al2O3 and Cu/Ti/Al2O3 interfaces
AU Dehm, G.; Scheu, C.; Ruhle, M.; Raj, R.
CS Max-Planck-Institut fur Metallforschung, Stuttgart, 70174, Germany
SO Acta Materialia (1998), 46(3), 759-772
CODEN: ACMAFD; ISSN: 1359-6454
PB Elsevier Science Ltd.
DT Journal
LA English
CC 56-6 (Nonferrous Metals and Alloys)
Section cross-reference(s): 57, 75
AB Thin Cu films and Cu/Ti bilayers were grown on (0001).alpha.-Al2O3 by mol. beam epitaxy (MBE) at substrate temps. ranging from 373 K to 473 K. Results on growth behavior, low-energy interface orientation relationships and the nature of bonding at the interfaces are reported. Transmission electron microscopy (TEM) and in-situ RHEED studies show that Cu/Ti bilayers nucleate and grow epitaxially on the Al2O3 substrates with an (111)Cu.ltbbrac.110.rtbbrac.Cu||(0001)Ti.ltbbrac.2.hivin.1.hivin.10.rtbbrac.Ti||(0001)Al2O3.ltbbrac.10.hivin.10.rtbbrac.Al2O3 orientation relationship. In contrast, Cu films on (0001).alpha.-Al2O3 grow in two stages. Initially, the Cu nuclei have random orientation but they realign with increasing film thickness into an heteroepitaxial (111)Cu.ltbbrac.110.rtbbrac.Cu||(0001)Al2O3.ltbbrac.10.hivin.10.rtbbrac.Al2O3 orientation relationship. In high-resoln. transmission electron microscopy (HRTEM) no reaction phases are obsd. at the atomically sharp Cu/Al2O3 and Ti/Al2O3 interfaces. Electron energy-loss spectroscopy (EELS) of the interfaces reveals bonding between copper or titanium and the oxygen sublattice of Al2O3. The interfacial widths of copper and titanium atoms involved in the bonding are estd. using the characteristic absorption edge data. In the case of Ti/Al2O3 the interfacial width is 0.5 nm .+-. 0.1 nm. The lower affinity of Cu to oxygen results in a smaller interfacial width of 0.34 nm .+-. 0.06 nm. These values correspond to the apparent fraction of the metal layers that participate in the bonding with the oxygen sublattice of (0001).alpha.-Al2O3.
ST copper MBE alumina interface titanium

L104 ANSWER 17 OF 19 INSPEC

AN 2001:6895216 INSPEC DN A2001-10-7865K-032; B2001-05-0520D-027

TI Polarized and electronic Raman scattering in GaN epitaxial layers grown on sapphire.

AU Tripathy, S.; Soni, R.K. (Dept. of Phys., Indian Inst. of Technol., New Delhi, India); Asahi, H.; Gonda, S.

SO Proceedings of the SPIE - The International Society for Optical Engineering (2000) vol.3975, pt.1-2, p.283-6. 6 refs.
Published by: SPIE-Int. Soc. Opt. Eng
CODEN: PSISDG ISSN: 0277-786X
SICI: 0277-786X(2000)3975:1/2L.283:PERS;1-F
Conference: Tenth International Workshop on the Physics of Semiconductor Devices. New Delhi, India, 14-18 Dec 1999

DT Conference Article; Journal

TC Theoretical; Experimental

CY United States

LA English

AB We have carried out a detail Raman scattering studies in GaN layers grown on C-, A-, R-, and **M-plane sapphire substrates** by electron cyclotron resonance molecular beam epitaxy (ECR-MBE) technique. First order optical phonons of A1, E1 and E2 symmetries were observed in the Raman spectra of GaN layers grown on **sapphire substrates**, where the peaks are indicative of the wurtzite crystal structure. Polarized Raman measurements performed on GaN layers grown on various orientations of **sapphire** exhibit quasipolar modes of both E1 and A1 symmetries. The appearance of these quasipolar phonons are explained by considering the combined effect of long range electrostatic and short range inter atomic forces in the Raman process. Furthermore, the nature of the electronic state is investigated by defect induced Raman scattering in resonance with yellow luminescence transitions in GaN layers grown on **C-plane sapphire**.

teaches growing an M-plane but no rot. no HEP. 10/28/02 09/927,223

AN 1999-0524026 PASCAL

TIEN Optical anisotropy of GaN/sapphire studied by generalized ellipsometry and Raman scattering
Light-emitting diodes : research, manufacturing, and applications III : San Jose CA, 27-28 January 1999

AU CHUNHUI YAN; YAO H. W.; VAN HOVE J. M.; WOWCHAK A. M.; CHOW P. P.; ZAVADA J. M.
SCHUBERT E. Fred (ed.); FERGUSON Ian T. (ed.); YAO H. Walter (ed.)

CS University of Nebraska, Center for Microelectronic and Optical Material Research, and Department of Electrical Engineering, Lincoln, NE 68588, United States; SVT Associates, Eden Prairie, MN, United Kingdom; European Research Office, London, United Kingdom
International Society for Optical Engineering, Bellingham WA, United States (patr.)

SO SPIE proceedings series, (1999), 3621, 73-84, 18 refs.
Conference: Light-emitting diodes. Conference, San Jose CA (United States), 27 Jan 1999
ISSN: 1017-2653
ISBN: 0-8194-3091-9

DT Journal; Conference

BL Analytic

CY United States

LA English

AV INIST-21760, 354000084598860080

AB Generalized variable angle spectroscopic ellipsometry (VASE) and Raman scattering have been employed to study the optical anisotropy of GaN/ **Sapphire** structures. The GaN films were grown by hydride vapor phase epitaxy (HVPE) and molecular beam epitaxy (MBE) on both **m -plane** and **c-plane sapphire** (. **alpha.**-Al.sub.2O.sub.3) **substrates**, respectively. Anisotropic optical phonon structure of **sapphire** have been measured, based on which the optical axis of **sapphire substrate** has been determined. A 541 cm.sup.-.sup.1 TO phonon of GaN grown on **m-plane sapphire substrate** has been discovered experimentally which is due the coupling of A.sub.1 and E.sub.1 TOs. Optical axis orientation of GaN film on m-**sapphire** has been fully determined by the anisotropic angular dependence of the coupled TO phonon. Off-diagonal elements A.sub.p.sub.s.sub.t and A.sub.s.sub.p.sub.t of transmission VASE (TVASE) are very sensitive parameters related to the optical anisotropy. The optical axis orientation of GaN on m-**sapphire** has also been accurately determined by TVASE at two special sample positions. The optical anisotropy due to GaN film and **sapphire substrate** has been successfully separated at 90.degree. sample position allowing to study the optical anisotropy of GaN film only.

L104 ANSWER 1 OF 19 WPIX (C) 2002 THOMSON DERWENT
AN 2001-079727 [09] WPIX
DNN N2001-060682 DNC C2001-022867
TI Structure for optoelectronic devices, e.g. edge emitting lasers, includes substrate with upstanding mesa(s) and a **nitride** epitaxial film on top of the mesa which has surfaces oriented along crack planes of epitaxial film.
DC L03 U11 U12 V08
IN BOUR, D P; DUNNROWICZ, C J; ROMANO, L T
PA (XERO) XEROX CORP
CYC 1
PI US 6163557 A 20001219 (200109)* 10p H01L031-0312
ADT US 6163557 A US 1998-82154 19980521
PRAI US 1998-82154 19980521
IC ICM H01L031-0312
ICS H01S005-00
AB US 6163557 A UPAB: 20010213

NOVELTY - A structure comprises a **substrate** (20) with upstanding mesa(s) (10) having a top surface (16), and a group III-V **nitride** epitaxial film on the top surface of the mesa. The mesa has surfaces oriented along crack planes of the epitaxial film.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for a method of forming the structure by patterning a **substrate** to form at least one mesa and epitaxially growing a group III-V **nitride** epitaxial film on top surface of the mesa.

USE - The structure is used for optoelectronic devices e.g., edge emitting lasers or surface emitting lasers, that emit visible light over a wide range of wavelengths.

ADVANTAGE - The improved structure has reduced cracking with improved electrical and optoelectronic properties, thus optoelectronic devices comprising the improved structure will have enhanced device performance and reliability.

DESCRIPTION OF DRAWING(S) - The figure shows mesas patterned on a **c-plane sapphire substrate** having an a-plane flat.

Mesa 10
Side surfaces 12
End surfaces 14
Top surface 16
Substrate 20
A-plane flat 22
Width W
Dwg.1/6

TECH US 6163557 A UPTX: 20010213

TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Components: The **substrate** is **sapphire** and also includes a thinned membrane. The epitaxial film comprises gallium **nitride** (GaN) and the structure also includes an aluminum gallium **nitride** epitaxial film having an aluminum concentration of up to 18% on the GaN film.

TECHNOLOGY FOCUS - ELECTRONICS - Preferred Component: Each of the mesas is disposed on a **c-plane** or a-plane (22) of the **substrate.** The top surface of each mesa has width (W) of not more than 10 (preferably 2-4) microns. The mesas are spaced 4-50 microns from each other, and also include side (12) and end (14) surfaces oriented along **m-planes** of the epitaxial film.

Preferred Method: The patterning step comprises reactive ion etching of the **substrate** or ablating the **substrate** using an excimer laser. The method also includes thinning the **substrate** to form a membrane and forming the mesa(s) on the membrane.

FS CPI EPI

L1 ANSWER 6 OF 27 CAPLUS
AN 1973:529998 CAPLUS
DN 79:129998
TI Nonbasal slip in sapphire
AU Gooch, D. J.; Groves, G. W.
CS Dep. Metall., Univ. Oxford, Oxford, Engl.
SO Phil. Mag. (1973), 28(3), 623-37
CODEN: PHMAA4
DT Journal
LA English
CC 70-2 (Crystallization and Crystal Structure)
AB The plastic deformation of sapphire by mechanisms other than slip on the basal plane was studied by bending crystals of orientations such that extension and contraction normal to the basal plane (0.degree. specimens) or parallel to the basal plane (90.degree. specimens) are required. 0.degree. specimens could not be plastically bent below 1600.degree.. Above 1600.degree. there was extensive plasticity but no single slip system could be identified. 90.degree. specimens could be plastically bent by the operation of the {21.hivin.1.hivin.0}.ltbbrac.**011.** **hivin.0**.rtbbrac. slip system at temps. as low as 1150.degree.. The temp. dependences and strain rate sensitivities of the flow stresses for 0.degree. and 90.degree. were detd. There are striking differences between the characteristics of the 2 types of deformation, which are attributed to the fact that different dislocations are involved.
ST sapphire nonbasal slip dislocation
IT 1317-82-4
RL: PRP (Properties)
(nonbasal slip in)

AN 1995:848758 HCAPLUS
DN 123:354908
TI Crystal structure and orientation of AlxIn1-xN epitaxial layers grown on (0001) .alpha.-Al2O3 substrates
AU Guo, Qixin; Itoh, Nobuo; Ogawa, Hiroshi; Yoshida, Akira
CS Fac. Sci. Eng., Saga Univ., Saga, 840, Japan
SO Japanese Journal of Applied Physics, Part 1: Regular Papers, Short Notes & Review Papers (1995), 34(9A), 4653-7
CODEN: JAPNDE; ISSN: 0021-4922
PB Japanese Journal of Applied Physics
DT Journal
LA English
CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 76
AB The epitaxial layers of AlxIn1-xN grown on (0001) .alpha.-Al2O3 substrates by microwave-excited OMVPE were studied using the RHEED and x-ray diffraction methods. All AlxIn1-xN layers have a wurtzite structure, as expected from the structure of AlN and InN. The epitaxial relation between the AlxIn1-xN layers and the (0001) .alpha.-Al2O3 substrates is (0001)AlxIn1-xN//(0001).alpha.-Al2O3 with [10.hivin.10]AlxIn1-xN//[10.hivin.10].alpha.-Al2O3. The lattice consts. of a and c axes of the epitaxial layers are detd. Both the a lattice const. and c/a ratio of the epitaxial AlxIn1-xN layers decrease with increasing molar fraction of x of the alloy.
ST aluminum indium nitride epitaxy structure orientation; alumina substrate aluminum indium nitride OMVPE

ANSWER 1 HCAPLUS COPYRIGHT 2002 ACS
AN 1997:405242 HCAPLUS
DN 127:168737
TI High quality optoelectronic grade epitaxial AlN films on .alpha.-Al2O3, Si and 6H-SiC by pulsed laser deposition
AU Vispute, R. D.; Narayan, J.; Budai, J. D.
CS Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC, 27695-7916, USA
SO Thin Solid Films (1997), 299(1-2), 94-103
CODEN: THSFAP; ISSN: 0040-6090
PB Elsevier
DT Journal
LA English
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 66, 75, 76
AB AlN is 1 of the most important optoelectronic materials in the wide band gap III-V semiconductors because of its wide and tunable energy band gap in conjunction with other nitrides, high thermal cond., doping capabilities, and high hardness. The proposed optoelectronic devices require high quality epitaxial films on various substrates. Here, the authors present recent work on the fabrication of high quality epitaxial AlN films on Al2O3(0001), Si(111) and 6H-SiC(0001) by pulsed laser deposition (PLD). The PLD is a nonequil. technique where thin film growth temp. can be reduced by >250-350.degree. and epitaxial films comparable in quality to MOCVD (equil. technique) obtained. The laser fluence and the substrate temp. are crucial processing parameters for the formation of high quality monocryst. AlN films. The AlN films deposited >750.degree. and laser energy densities of 2-3 J cm-2 are epitaxial with c-axis normal to substrate plane. The x-ray rocking curve of epitaxial films on sapphire and SiC yielded full-width-at-half-max. of .apprx.0.06-0.07.degree.. The TEM also revealed that the films were epitaxial with an orientational relation of AlN[0001].dblvert.Al2O3[0001], AlN[0001].dblvert.Si[111], AlN[0001].dblvert.SiC[0001] and in-plane alignment of AlN[.hivin.12.hivin.10].dblvert. Al2O3[0.hivin.110], AlN[10.hivin.10].dblvert.Al2O3[.hivin.2110], AlN[2.hivin.1.hivin.10].dblvert.Si[01.hivin.1] and AlN[0.hivin.110].dblvert.SiC[0.hivin.110]. The optical absorption edge measured by UV-visible spectroscopy for the epitaxial AlN film on sapphire was sharp and the band gap is 6.1 eV. The elec. resistivity of the films was .apprx.5-6 .times. 1013 .OMEGA. cm-1 with a breakdown field of 5 .times. 106 V cm-1.
ST aluminum nitride laser deposition optoelectronic grade; Raman aluminum nitride laser deposition; IR aluminum nitride laser deposition; band gap

AN 1995:797114 HCAPLUS
DN 123:325997
TI High quality epitaxial aluminum nitride layers on sapphire by pulsed laser deposition
AU Vispute, R. D.; Wu, Hong; Narayan, J.
CS Dep. of Materials Science and Engineering, North Carolina State University, Raleigh, NC, 27695-7916, USA
SO Applied Physics Letters (1995), 67(11), 1549-51
CODEN: APPLAB; ISSN: 0003-6951
PB American Institute of Physics
DT Journal
LA English
CC 75-1 (Crystallography and Liquid Crystals)
Section cross-reference(s): 73, 76
AB The authors have grown high quality epitaxial AlN layers on sapphire substrates by pulsed laser ablation of a stoichiometric AlN target. The AlN films deposited at 800.degree. and laser energy densities at 2-3 J/cm2 are epitaxial with the c axis normal to the Al2O3(0001) surface. The x-ray rocking curve of epitaxial AlN films yielded a full width at half max. of 0.21.degree.. The selected area electron diffraction patterns and high resoln. TEM also revealed that the films were epitaxial with an orientational relation of AlN[0001]||Al2O3[0001] and in-plain alignment of AlN[.hivin.12.hivin.10]||Al2O3[0.hivin.110] and AlN[10.hivin.10]||Al2O3[.hivin.2110]. This equiv. to 30.degree. rotation in the basal plane of the AlN film with respect to the sapphire substrate. The absorption edge measured by UV-visible spectroscopy for the epitaxial AlN film was sharp and the band gap is 6.1 eV. The elec. resistivity of the films was .apprx.5-6 .times. 1013 ohm cm with a breakdown field of 5 .times. 106 V/cm. At higher laser energy densities .gtoreq.10 J/cm2 and lower temps. .ltoreq.650.degree., the deposited films were N deficient and contained free metallic Al, both of which degrade the microstructural, elec., and optical properties of the AlN films.
ST laser epitaxy aluminum nitride elec optical

L8 ANSWER 3 OF 4 HCAPLUS COPYRIGHT 2002 ACS
AN 1990:600278 HCAPLUS
DN 113:200278
TI Growth and properties of a wide-gap semiconductor indium gallium nitride
AU Matsuoka, Takashi; Sasaki, Toru; Katsui, Akinori
CS Opto-Electron. Lab., NTT, Tokai, 319-11, Japan
SO Optoelectronics--Devices and Technologies (1990), 5(1), 53-64
CODEN: ODTEEG; ISSN: 0912-5434
DT Journal
LA English
CC 73-2 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 75
AB The quaternary semiconductor InGaAlN, which has a wide bandgap energy, is proposed as a material for blue light-emitting devices. This material is a III-V system. It consists of InN, GaN and AlN with the wurtzite structures. Its bandgap energy can be selected from 2.0 to 6.2 eV. This material is promising for light-emitting devices, in particular, laser diodes. A lattice-matched double-heterostructure can theor. be constructed of this material, since large changes in bandgap energy occur for a fixed lattice const. Epitaxial growth of single-crystal InN, the most difficult to grow of the 3 binary compds. of InGaAlN, was achieved on **sapphire** (0001) substrates by metalorg. vapor phase epitaxy. Low temp. and high V/III ratio are found to be necessary. Single-crystal InGaN has also been grown on **sapphire** (0001) substrates. Its compn. can be continuously controlled from GaN to InN by the flow rate ratio of the group III sources. In epitaxial films of GaN, flatter surfaces were achieved using **sapphire** (**01.**
hivin.10) substrates.

L6 ANSWER 26 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1981:74891 HCAPLUS
DN 94:74891
TI Atom location in complex lattices: lead in .alpha.-aluminum oxide
AU Carnera, A.; Drigo, A. V.; Mazzoldi, P.
CS Ist. Fis., Univ. Padova, Padua, Italy
SO Proc. - Int. Conf. Ion Beam Modif. Mater., 1st (1979), Meeting Date 1978, Volume 1, 297-303. Editor(s): Gyulai, J.; Lohner, T.; Pasztor, E. Publisher: Magy. Tud. Akad. Kozp. Fiz. Kut. Intez., Budapest, Hung. CODEN: 45ARA4
DT Conference
LA English
AB A Pb location is proposed according to data of full angular scans through different axial and planar channeling dips. Planar angular scans through the {1.hivin.210} and the {**01.hivin.10**} planes confirm that the Pb sites are located along the Al .ltbbrac.001.rtbbrac. rows. The Pb lattice positions can be considered as octahedral interstitial sites significantly displaced along the c-axis. This displacement amts. to 0.725 .ANG. and corresponds to 1/18 of the c0 lattice const. of the corundum structure.
IT **1344-28-1**, properties

L6 ANSWER 21 OF 36 HCAPLUS
AN 1991:548071 HCAPLUS
DN 115:148071
TI Optical properties of indium antimonide films deposited on sapphire substrates by rf sputtering
AU Miyazaki, Takayuki; Adachi, Sadao
CS Fac. Eng., Gunma Univ., Gunma, 376, Japan
SO Journal of Applied Physics (1991), 70(3), 1672-7
CODEN: JAPIAU; ISSN: 0021-8979
DT Journal
LA English
AB InSb films were deposited by rf sputtering on sapphire substrate of various surface orientations [(0001), (11.hivin.20), (01.hivin.12), and (**01.hivin.10**)]. Optical properties of these films are investigated by using spectroscopic ellipsometry. The epitaxial film has a few void networks in the film. Polycryst. InSb films, on the other hand, contain a large no. of void networks deep in the film medium. Both epitaxial and polycryst. films have rough-surface overlayers of a few tens of .ANG..
IT **1317-82-4**, Sapphire

L6 ANSWER 16 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:24169 HCAPLUS
DN 124:64137
TI High-quality epitaxial growth of .gamma.-alumina films on .alpha.-alumina sapphire induced by ion-beam bombardment
AU Yu, Ning; McIntyre, Paul C.; Nastasi, Michael; Sickafus, Kurt E.
CS Mater. Sci. Technol. Div., Los Alamos Natl. Lab., Los Alamos, NM, 87545, USA
SO Physical Review B: Condensed Matter (1995), 52(24), 17518-22
CODEN: PRBMDO; ISSN: 0163-1829
PB American Physical Society
DT Journal
LA English
AB We report the formation of epitaxial .gamma.-alumina thin films on .alpha.-alumina substrates induced by ion-beam bombardment. Single-crystal (0001) .alpha.-alumina was coated with 70-nm amorphous-alumina thin films and then bombarded with either 360-keV argon ions or 180-keV oxygen ions at 400, 500, and 600.degree.C. Ion-channeling measurements showed a consistent min. yield of 50% for the aluminum in the grown films. Cross-sectional transmission-electron microscopy revealed the formation of .gamma.-alumina epitaxially grown onto .alpha.-alumina with an orientation relationship [1.hivin.10](111).gamma.||[**01.hivin.10**](0001).alpha.. The epitaxy of .gamma.-alumina was further confirmed by x-ray-diffraction .vphi. scans. This study indicates that ion-beam bombardment at 400-600.degree.C not only induces the amorphous-to-.gamma. phase transformation but also effectively eliminates {111} twins of .gamma.-alumina, which are normally obsd. after thermal annealing at 800-900.degree.C.
IT **1344-28-1**, Alumina, processes

L6 ANSWER 14 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:141443 HCAPLUS
DN 124:216410
TI Aluminum nitride films on different orientations of sapphire and silicon
AU Dovidenko, K.; Oktyabrsky, S.; Narayan, J.; Razeghi, M.
CS Dep. of Materials Science and Engineering, North Carolina State Univ., Raleigh, NC, 27695-7916, USA
SO Journal of Applied Physics (1996), 79(5), 2439-45
CODEN: JAPIAU; ISSN: 0021-8979
PB American Institute of Physics
DT Journal
LA English
AB The details of epitaxial growth and microstructural characteristics of AlN films grown on sapphire (0001), (10.hivin.12) and Si (100), (111) substrates were studied using plan-view and cross-sectional high-resoln. TEM and x-ray diffraction techniques. The films were grown by metalorg. CVD using TMAl + NH3 + N2 gas mixts. Different degrees of epitaxy were obsd. for the films grown on .alpha.-Al2O3 and Si substrates in different orientations. The epitaxial relation for (0001) sapphire is (0001)AlN.dblvert.(0001)sap with in-plane orientation relation of [**01.hivin.10**]AlN.dblvert.[.hivin.12.hivin.10]sa
p. This is equiv. to a 3.degree. rotation in the basal (0001) plane. For (10.hivin.12) sapphire substrates, the epitaxial relation is (11.hivin.20)AlN.dblvert.(10.hivin.12)sap with the in-plane alignment of [0001]AlN.dblvert.[.hivin.1011]sap. The AlN films on (0001) .alpha.-Al2O3 contain inverted domain boundaries and a/3.ltbbrac.11.hivin.20.rtbbrac. threading dislocations with the estd. d. of 1010 cm-2. The d. of planar defects (stacking faults) found in AlN films was considerably higher in the case of (10.hivin.12) compared to (0001) substrates. Films on Si substrates are highly textured c axis oriented when grown on (111) Si, and c axis textured with random in-plane orientation on (100) Si. The role of thin-film defects and interfaces on device fabrication is discussed.
IT **1344-28-1**, Alumina, processes

L6 ANSWER 12 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:293139 HCAPLUS
DN 124:323489
TI Thermal stability of Nb thin films on sapphire
AU Wagner, Thomas; Lorenz, Marko; Ruehle, Manfred
CS Inst. Werkstoffwissenschaft, Max-Planck-Inst. Metallforschung, Stuttgart, 70174, Germany
SO Journal of Materials Research (1996), 11(5), 1255-1264
CODEN: JMREEE; ISSN: 0884-2914
PB Materials Research Society
DT Journal
LA English
AB The Nb/.alpha.-Al2O3 system has been used as a model study for investigating the stability of different mol. beam epitaxy (MBE) grown epitaxial Nb films on .alpha.-Al2O3 substrates. The films were grown at 800 .degree.C in ultrahigh vacuum. The growth process was monitored in situ by RHEED. After deposition the structure of the film was investigated by x-ray diffraction (XRD) and conventional transmission electron microscopy (CTEM) which encompasses also selected area diffraction (SAD). Both techniques revealed the following orientation relationship between the Nb film and the .alpha.-Al2O3 substrate: (0001).alpha.-Al2O3 ||(111)Nb; [2.hivin.1.hivin.10].alpha.-Al2O3||[1.hivin.10]Nb. The stability of the niobium films was investigated by annealing the Nb-film/.alpha.-Al2O3 system to temps. up to 1500 .degree.C for different periods of time. Surprisingly, the orientation relationship between the Nb film and the substrate changed to (001).alpha.-Al2O3||(110)Nb; [**01.hivin.10**].alpha.-Al2O3||[001]Nb. A model will be developed which shows that above a crit. film thickness the growth orientation is metastable with respect to its crystallog. orientation. Furthermore, high resoln. transmission electron microscopy (HREM) was performed to investigate the defect structure of the annealed Nb/.alpha.-Al2O3 interface.
IT **1302-74-5**, Corundum (Al2O3), uses

L6 ANSWER 11 OF 36 HCAPLUS
AN 1996:485336 HCAPLUS
DN 125:127320
TI Manufacture of gallium nitride compound semiconductor lasers
IN Sugimoto, Yasunobu; Nakamura, Shuji
PA Nichia Kagaku Kogyo Kk, Japan
SO Jpn. Kokai Tokkyo Koho, 5 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 08153931	A2	19960611	JP 1994-295433	19941130
	JP 2953326	B2	19990927		

AB The LD manuf. involves laminating GaN-based semiconductor layers on a (0001) surface of a sapphire substrate and cutting the substrate in the face direction (1.hivin.100), (10.hivin.10), (**01.hivin .10**), (.hivin.1100), (.hivin.1010), or (0.hivin.110) to give a resonator facet.
IT **1317-82-4**, Sapphire

L6 ANSWER 10 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:567949 HCAPLUS
DN 125:309661
TI The microstructural study of aluminum nitride thin films: epitaxy on the two orientations of sapphire and texturing on Si
AU Dovidenko, K.; Oktyabrsky, S.; Narayan, J.; Razeghi, M.
CS Dep. Mater. Sci. Eng., North Carolina State Univ., Raleigh, NC, 27695-7916, USA
SO Materials Research Society Symposium Proceedings (1996), 395(Gallium Nitride and Related Materials), 387-392
CODEN: MRSPDH; ISSN: 0272-9172
PB Materials Research Society
DT Journal
LA English
AB The microstructural study of wide-band gap semiconductor AlN thin films grown on (0001) and (10.hivin.12) sapphire and (111), (100) Si was carried out by using plan-view and cross-sectional high-resoln. electron microscopy and x-ray diffraction. The films were grown by MOCVD from a Me3Al + NH3 + N2 gas mixt. Epitaxial relationship for AlN grown on (0001) .alpha.-Al2O was detd. to be (0001)Aln.dblvert.(0001)sap with the 300 in-plane rotation **[01 .hivin.10**]AlN.dblvert.[.hivin.12.hivin.10]sap. TEM observations were also made of the epitaxial relationship of the AlN/(10.hivin.12).alpha.-Al2O3 heterostructure: (11.hivin.20)AlN.dblvert.(10.hivin.12)sap; [0001]Al#N.dblvert.[.hivin.1-11]sap; [1.hivin.100]AlN.dblvert.[1.hivin.210]sap. These epitaxial relations are controlled by the bonding of Al and O ions at the interface. A study of interfaces and defects present in the film was also carried out. The main types of defects are inverted domain boundaries, misfit and threading dislocations (in the films on (0001) sapphire), and stacking faults of high d. in the films on (10.hivin.12) sapphire. The epitaxial AlN films on (0001) sapphire contain dislocation d. .apprx. 1010 cm-2 and exhibit device quality elec. characteristics. The films on both orientations of Si are highly .ltbbrac.0001.rtbbrac. textured polycryst.
IT **1344-28-1**, Alumina, properties

L6 ANSWER 9 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1996:588336 HCAPLUS
DN 125:208014
TI Nitride-type semiconductor laser with dielectric multilayer-coated resonator surface
IN Senoo, Masayuki; Yamada, Takao; Nakamura, Shuji
PA Nichia Kagaku Kogyo Kk, Japan
SO Jpn. Kokai Tokkyo Koho, 7 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 08191171	A2	19960723	JP 1995-3033	19950112
	JP 2002171024	A2	20020614	JP 2001-361772	19950112
PRAI	JP 1995-3033	A3	19950112		

AB The LD consisting of laminated InxAlyGa1-x-yN (0.ltoreq. x, 0.ltoreq. y, x + y .ltoreq.1) semiconductor layers has a dielec. multilayer film on an optical resonator surface. The LD having the dielec. multilayer film of SiO2, TiO2, and/or ZrO2 may have an emitting wavelength at 360-460 nm. The [0001] surface of a sapphire substrate may be used for laminating the semiconductor layers and the [1.hivin.100], [10.hivin.10], [**01.hivin.10**], [.hivin.1100], [.hivin.1010], or [0.hivin.110] surface of the substrate may be used for forming an optical resonator surface on an edge face of the semiconductor layers perpendicular to the substrate.
IT **1317-82-4**, Sapphire

L8 ANSWER 1 OF 4 HCAPLUS COPYRIGHT 2002 ACS
AN 1998:816423 HCAPLUS
DN 130:102676
TI Growth of gallium nitride thin film for semiconductor light emitting device
IN Kimura, Akitaka; Sasaoka, Chiaki; Yamaguchi, Atsushi; Jindo, Masaaki
PA NEC Corp., Japan
SO Jpn. Kokai Tokkyo Koho, 5 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM H01S003-18
ICS H01L021-205; H01L033-00
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 75
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 10341060	A2	19981222	JP 1997-150761	19970609
	JP 3119200	B2	20001218		

AB The title method comprises the growth of an InxAlyGa1-x-yN [0.ltoreq.x.ltoreq.1, 0.ltoreq.y.ltoreq.1, and 0.ltoreq.x+y.ltoreq.1] layer with a (11.hivin.22) plane on a **sapphire** substrate with (**01.hivin.10**) orientation (M plane) by MOVPE.
ST aluminum gallium indium nitride **sapphire** MOVPE semiconductor

L6 ANSWER 7 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1997:313687 HCAPLUS
DN 127:24252
TI Atomic structure of epitaxial Nb-Al2O3 interfaces. I. Coherent regions
AU Gutekunst, G.; Mayer, J.; Ruehle, M.
CS Max-Planck-Institut fur Metallforschung, Institut fur Werkstoffwissenschaft, Stuttgart, 70174, Germany
SO Philosophical Magazine A: Physics of Condensed Matter: Structure, Defects and Mechanical Properties (1997), 75(5), 1329-1355
CODEN: PMAADG; ISSN: 0141-8610
PB Taylor & Francis
DT Journal
LA English
AB Thin single-crystal Nb films were grown on (0001)s, (**01.hivin.10**)s, (2.hivin.1.hivin.10)s and (01.hivin.12)s .alpha.-Al2O3 (sapphire) surfaces by mol.-beam epitaxy. The same orientation relation between the bulk of the Nb films and the sapphire substrates is obsd. for all four systems. The at. structure of the interface between the Nb films and the sapphire substrates was detd. by high-resoln. TEM (HRTEM). The HRTEM studies revealed a unique building principle for the at. structure of all studied Nb-Al2O3 interfaces. Two rules characterize the building principle. The 1st rule states that Nb atoms or ions occupy Al lattice sites at the interface. This rule dets. the position of the Nb atoms or ions of the 1st plane at the interface and thus the growth direction. The 2nd rule dets. the orientation of the Nb crystal with respect to the 1st Nb layer. According to the 2nd rule the Nb atoms of the 2nd layer adjacent to the interface are positioned as close as possible to the Al lattice sites of a continued Al lattice of the sapphire. The unique building principle is established because the bcc. unit cell of the Nb corresponds closely to the morphol. unit cell of sapphire. The morphol. unit cell connects the Al lattice sites in the sapphire lattice. The correspondence between the two unit cells, the unique building principle and in the case of the (01.hivin.12)s system the dislocation network explain the formation of the same orientation relation for all systems studied.
IT **1344-28-1**, Alumina, properties
RL: PRP (Properties)

L6 ANSWER 6 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1997:313688 HCAPLUS
DN 127:24253
TI Atomic structure of epitaxial Nb-Al2O3 interfaces. II. Misfit dislocations
AU Gutekunst, G.; Mayer, J.; Vitek, V.; Ruehle, M.
CS Max-Planck-Institut fur Metallforschung, Institut fur Werkstoffwissenschaft, Stuttgart, 70174, Germany
SO Philosophical Magazine A: Physics of Condensed Matter: Structure, Defects and Mechanical Properties (1997), 75(5), 1357-1382
CODEN: PMAADG; ISSN: 0141-8610
PB Taylor & Francis
DT Journal
LA English
AB Four Nb-Al2O3 interfaces were generated by depositing Nb on (0001)s, (**01.hivin.10**)s, (2.hivin.1.hivin.10)s and (01.hivin.12)s .alpha.-Al2O3 (sapphire) surfaces by MBE. High-resoln. TEM (HRTEM) studies showed that the interfaces are semicoherent for the film thicknesses studied, that is coherent regions alternate with misfit dislocations at the interfaces. The visible displacement field around the core of the dislocations is restricted to the Nb lattice. The Burgers vector of the misfit dislocations is therefore assigned to the lattice of the Nb. The Burgers vector is detd. by HRTEM using the concept of a Burgers circuit around the core of the misfit dislocations. Since this core is in general at the interface, the Burgers circuit has to cross the interface. The dislocation networks, which accommodate the mismatch between the lattice of the Nb and the sapphire, are built up by misfit dislocations with a Burgers vector of 1/2 <111>. This Burgers vector to the misfit dislocations is not always parallel to the interface nor are all misfit dislocations pure edge dislocations. Only the edge component bMD of the Burgers vector, which is parallel to the interface, accommodates the lattice mismatch at these interfaces. Screw components bscrew and/or edge components b.perp. which are perpendicular to the interface, are in general compensated in the networks. Only in the system where the interface is parallel to (01.hivin.12)s does an array of misfit dislocations with an uncompensated Burgers vector component b.perp. lead to a tilt of the Nb lattice with respect to the sapphire lattice.
IT **1344-28-1**, Alumina, properties

L6 ANSWER 5 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1997:590365 HCAPLUS
DN 127:286112
TI Basal slip in sapphire (.alpha.-Al2O3)
AU Castaing, J.; Munoz, A.; Gomez Garcia, D.; Dominguez Rodriguez, A.
CS Departamento Fisica de la Materia Condensada, Universidad y CSIC, Aprtado. 1065, Seville, 41080, Spain
SO Materials Science & Engineering, A: Structural Materials: Properties, Microstructure and Processing (1997), A233(1-2), 121-125
CODEN: MSAPE3; ISSN: 0921-5093
PB Elsevier
DT Journal
LA English
AB Plastic deformation of sapphire was performed along three different compression axes to activate (0001) basal slip along one or two .ltbbrac..hivin.1.hivin.120.rtbbrac. directions. One of the orientations is identical to that used in earlier expts., with the activation of one glide direction, or Burgers vector. Two new orientations were also studied which permit activation of two Burgers vectors. For one of these orientations, rhombohedral twinning is difficult to activate and large deformations, for unpolished specimens, can be reached by basal slip down to 900.degree.. Basal glide along .ltbbrac.**01.hivin.10**.rtbbrac. was obsd.; the yield stress values are the same for .ltbbrac.**01.hivin.10**.rtbbrac. and .ltbbrac.0.hivin.110.rtbbrac. directions.

L6 ANSWER 4 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1998:514434 HCAPLUS
DN 129:252651
TI Defects and interfaces in epitaxial ZnO/.alpha.-Al2O3 and AlN/ZnO/.alpha.-Al2O3 heterostructures
AU Narayan, J.; Dovidenko, K.; Sharma, A. K.; Oktyabrsky, S.
CS Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC, 27695-7916, USA
SO Journal of Applied Physics (1998), 84(5), 2597-2601
CODEN: JAPIAU; ISSN: 0021-8979
PB American Institute of Physics
DT Journal
LA English
AB The nature of epitaxy, defects (dislocations, stacking faults, and inversion domains), and heterointerfaces in Zn oxide films grown on (0001) sapphire was investigated, and the possibility of using it as a buffer layer for growing Group III nitrides was explored. High quality epitaxial ZnO films were grown on sapphire using pulsed laser deposition at 750-800.degree.. The epitaxial relation of the film with respect to (0001) sapphire is (0001)ZnO.dblvert.(0001)sap, with in-plane orientation relation of [**01.hivin.10**
]ZnO.dblvert.[.hivin.12.hivin.10]sap. This in-plane orientation relation corresponds to a 30.degree. rotation of ZnO basal planes with respect to the sapphire substrate, which is similar to the epitaxial growth characteristics of AlN and GaN on sapphire. The threading dislocations in ZnO have mostly 1/3.ltbbrac.11.hivin.20.rtbbrac. Burgers vectors. The planar defects (mostly I1 stacking faults) lie in the basal plane with d. of .apprx.105 cm-1. Epitaxial AlN films were grown at around 770.degree. using ZnO/sapphire heterostructure as a substrate and the formation of a thin reacted layer at the AlN/ZnO interface was obsd. The implications of low defect content in ZnO films compared to III-V nitrides and the role of ZnO films as a buffer layer for III-V nitrides are discussed.
IT **1344-28-1**, Alumina, properties

L6 ANSWER 2 OF 36 HCAPLUS COPYRIGHT 2002 ACS
AN 1998:782544 HCAPLUS
DN 130:74424
TI TEM characterization of ZnO and AlN/ZnO thin films grown on sapphire
AU Dovidenko, K.; Oktyabrasky, S.; Sharma, A. K.; Narayan, J.
CS Dept. of Materials Science & Engineering, North Carolina State University, Raleigh, NC, 27695-7916, USA
SO Materials Research Society Symposium Proceedings (1998), 526(Advances in Laser Ablation of Materials), 311-316
CODEN: MRSPDH; ISSN: 0272-9172
PB Materials Research Society
DT Journal
LA English
AB Thin (.apprx.250 nm) films of ZnO grown by pulsed laser deposition on the basal plane of sapphire were studied by TEM microscopy . Plan-view TEM study proved the films to be single crystal with the following epitaxial relation with the substrate: (0001)ZnO.dblvert.(0001)sap with the 300 in-plane rotation - [**01.hivin.10**]ZnO.dblvert.[.hivin.12.hivin.10]sap. Dislocations lying mostly in the basal plane of ZnO and aligned along both <10.hivin.10> and <11.hivin.20> directions having b = 1/3[11.hivin.20] were found. ZnO films were found to have layered growth morphol. contrary to the columnar morphol. of III nitrides. Consequently, the threading dislocation d. in ZnO films (opposed to AlN and GaN) drops very fast with the thickness: down to 107 cm-2 at .apprx.250 nm. The effect of post-annealing (which caused significant improvement in elec. and optical properties) on the microstructure of ZnO films was also studied. Contrary to the atomically sharp and clean interface in the as-deposited films, the post-annealed ZnO/sapphire interface contained reacted layer of 30-60 .ANG. thickness. The structure of the interlayer was detd. to be ZnAl2O4 (spinel). The formation of this single-crystal spinel layer did not cause deterioration of the ZnO film structure or properties. The authors have also explored the possibility of using ZnO as a buffer for III nitride growth. The epitaxial AlN films were grown on top of the ZnO layer by pulsed laser deposition. A thin (20-60 .ANG.) interfacial reaction layer (also spinel ZnAl2O4) was obsd. between AlN and ZnO. Formation of this interlayer is studied in conjunction with the AlN epitaxy and the characteristics of defects and interfaces.
IT **1317-82-4**, Sapphire

L8 ANSWER 4 OF 4 HCAPLUS COPYRIGHT 2002 ACS
AN 1987:147273 HCAPLUS
DN 106:147273
TI Epitaxial growth of niobium thin films
AU Claassen, J. H.; Wolf, S. A.; Qadri, S. B.; Jones, L. D.
CS Nav. Res. Lab., Washington, DC, 20375-5000, USA
SO J. Cryst. Growth (1987), 81(1-4), 557-61
CODEN: JCRGAE; ISSN: 0022-0248
DT Journal
LA English
CC 75-1 (Crystallography and Liquid Crystals)
AB The properties of Nb films grown in a UHV-metal MBE-system are described. The films were characterized by high energy electron diffraction, various x-ray diffraction techniques, and transport measurements. The epitaxial relation between (0001), **(01.hivin.10)** and (11.hivin.20) **sapphire** substrates and the Nb films grown on them represents a 3-dimensional registry between the 2 lattices. Rocking curve widths, superconducting transition temps., and residual resistance ratios all are representative of very high quality films. An enhancement of the transition temp. by .apprx.0.3 K occurs in strained textured films grown at ambient temp. on the 3 orientations mentioned above. Epitaxy occurs on the (1.hivin.102) **sapphire** face at growth temps. as low as ambient.
ST epitaxy niobium **sapphire** mol beam; MBE niobium **sapphire**

L87 ANSWER 13 OF 13 SCISEARCH COPYRIGHT 2002 ISI (R)
AN 1998:803726 SCISEARCH
GA The Genuine Article (R) Number: 128QX
TI Properties of GaN epilayers grown on **misoriented sapphire substrates**
AU TragerCowan C (Reprint); McArthur S; Middleton P G; ODonnell K P; Zubia D; Hersee S D
CS UNIV STRATHCLYDE, DEPT PHYS & APPL PHYS, GLASGOW G1 1XQ, LANARK, SCOTLAND (Reprint); UNIV NEW MEXICO, CHTM, ALBUQUERQUE, NM 87131
CYA SCOTLAND; USA
SO MRS INTERNET JOURNAL OF NITRIDE SEMICONDUCTOR RESEARCH, (AUG 1998) Vol. 3, No. 36, pp. 1-8.
Publisher: MATERIALS RESEARCH SOCIETY, 506 KEYSTONE DR, WARRENDALE, PA 15086.
ISSN: 1092-5783.
DT Article; Journal
LA English
REC Reference Count: 24
AB Three silicon-doped 3 mu m thick GaN epilayers were grown simultaneously by metalorganic chemical vapour deposition on (0001) **sapphire substrates misorientated** by 0 degrees, 4 degrees and 10 degrees toward the **m-plane** (10 (1) over bar 0). A comparative study of these epilayers was undertaken using photoluminescence(PL) spectroscopy, atomic force microscopy (AFM), scanning electron microscopy (SEM), cathodoluminescence (CL) imaging, CL spectroscopy and Hall effect measurements. Low temperature PL of the 0 degrees and 4 degrees epilayers shows donor bound exciton (BE) emission between 3.47 and 3.48 eV and a low level of yellow band emission. The peak intensities of both emission bands are a factor of 2 higher for the 4 degrees layer. In the 10 degrees epilayer, the BE band is 3x stronger than in the 0 degrees epilayer but there is no discernible yellow band. However, a number of additional bands appear at 3.459, 3.417, 3.362, 3.345, 3.309, and 3.285 eV. These bands, some of which are acceptor related, may be attributed to the presence of structural defects in this epilayer, pointing to an abrupt degradation of its structural quality compared to the others. This degradation is confirmed by AFM studies. On a 20 mu m x 20 mu m image the 0 degrees and 4 degrees epilayers exhibit smooth surface morphologies, while the 10 degrees epilayer shows a high density of hexagonal pits. Finally, SEM images reveal the surface of the 10 degrees epilayer to be ''streaked'' and pitted. Low temperature ct images at 3.48 eV (bound exciton region) show random spotty emission, while those at 3.28 eV and 3.41 eV exhibit a streaky appearance similar to the SEM image. This suggests that these luminescence bands are indeed associated with structural defects.

AN 1991:195317 HCAPLUS
DN 114:195317
TI MOVPE growth of gallium nitride on a misoriented sapphire substrate
AU Hiramatsu, Kazumasa; Amano, Hiroshi; Akasaki, Isamu; Kato, Hisaki; Koide, Norikatsu; Manabe, Katsuhide
CS Dep. Electron., Nagoya Univ., Nagoya, 464-01, Japan
SO Journal of Crystal Growth (1991), 107(1-4), 509-12
CODEN: JCRGAE; ISSN: 0022-0248
DT Journal
LA English
CC 73-5 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 66, 75, 76
AB The effects of slight misorientation from a (0001) singular plane on .alpha.-Al2O3 substrates on the surface morphol. and luminescence properties of MOVPE-grown GaN films were studied. Macrostep morphol. with periodic terraces (singular plane) and risers (clustered steps) was obsd. on epitaxial GaN films grown on 3-10.degree. misoriented Al2O3 viniculum substrates toward the [10.hivin.10]sapphire and [1.hivin.210]sapphire directions. The macrostep causes inhomogeneity of cathodoluminescence and electroluminescence patterns in Zn-doped GaN films, suggesting that the Zn luminescence center formation depends on the growth planes of the terrace and riser.
ST luminescence gallium nitride film alumina; electroluminescence gallium nitride film alumina; cathodoluminescence gallium nitride film alumina; epitaxy gallium nitride film alumina; MBE gallium nitride film alumina

L31 ANSWER 1 OF 1 INSPEC COPYRIGHT 2002 IEE
AN 2000:6546778 INSPEC DN A2000-09-7865K-035
TI Optical anisotropy of GaN/sapphire studied by generalized ellipsometry and Raman scattering.
AU Yan, C.; Yao, H. (Center for Microelectron. & Opt. Mater. Res., Nebraska Univ., Lincoln, NE, USA); Van Hove, J.M.; Wowchak, A.M.; Chow, P.P.; Zavada, J.M.
SO Proceedings of the SPIE - The International Society for Optical Engineering (1999) vol.3621, p.73-84. 18 refs.
Published by: SPIE-Int. Soc. Opt. Eng
Price: CCCC 0277-786X/99/$10.00
CODEN: PSISDG ISSN: 0277-786X
SICI: 0277-786X(1999)3621L.73:OASS;1-Q
Conference: Light-Emitting Diodes: Research, Manufacturing, and Applications III. San Jose, CA, USA, 27-28 Jan 1999
Sponsor(s): SPIE
DT Conference Article; Journal
TC Experimental
CY United States
LA English
AB Generalized variable **angle** spectroscopic ellipsometry (VASE) and Raman scattering have been employed to study the optical anisotropy of GaN/**sapphire** structures. The GaN films were grown by hydride vapor phase **epitaxy** and molecular beam **epitaxy** on both m-plane and c-plane **sapphire** (**alpha -Al2O3**) **substrates**, respectively. Anisotropic optical phonon structure of **sapphire** has been measured, based on which the optical axis of **sapphire substrate** has been determined. A 541 cm-1 TO phonon of GaN grown on m-plane **sapphire substrate** has been discovered experimentally which is due the coupling of A1 and E1 TOs. Optical axis orientation of GaN film on m-**sapphire** has been fully determined by the anisotropic angular dependence of the coupled TO phonon. Off-diagonal elements Apst and Aspt of transmission VASE (TVASE) are very sensitive parameters related to the optical anisotropy. The optical axis orientation of GaN on m-**sapphire** has also been accurately determined by TVASE at two special sample positions. The optical anisotropy due to GaN film and **sapphire** **substrate** has been successfully separated at 90 degrees samples position allowing to study the optical anisotropy of GaN film only.

L104 ANSWER 11 OF 19 HCAPLUS COPYRIGHT 2002 ACS

AN 1999:333269 HCAPLUS

DN 131:94087

TI Optical properties of GaN layers grown on C-, A-, R-, and **M-plane sapphire substrates** by gas source molecular beam epitaxy

AU Tripathy, S.; Soni, R. K.; Asahi, H.; Iwata, K.; Kuroiwa, R.; Asami, K.; Gonda, S.

CS Department of Physics, Indian Institute of Technology Delhi, New Delhi, 110016, India

SO Journal of Applied Physics (1999), 85(12), 8386-8399
CODEN: JAPIAU; ISSN: 0021-8979

PB American Institute of Physics

DT Journal

LA English

CC 73-3 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 76

AB GaN layers were grown on C-, A-, R-, and **M-plane sapphire substrates** by the electron cyclotron resonance-MBE technique. The authors addressed a combined use of Raman spectroscopy, photoluminescence (PL) and reflectance measurements to study the optical properties of these high-quality GaN layers. First order optical phonons of A1, E1, and E2 symmetries were obsd. in the Raman spectra and the peaks are indicative of the wurtzite crystal structure. All three intrinsic exciton transitions arising from A, B, and C interband transitions were obsd. in reflectance measurements. The PL spectra were dominated by A and B free exciton transitions and the recombination of an exciton bound to a neutral donor. The exptl. data clearly revealed a thickness-dependent change of the biaxial strain in the GaN layers grown on (0001) **C-plane sapphire**. The residual strain induced in these layers has a strong influence in detg. the energies of the excitonic transitions. Resonant Raman scattering measurements were performed by temp. tuning of fundamental gap in 1.0 .mu.m GaN on **C-plane sapphire**. The influence of epitaxial strain in free exciton properties of GaN layers grown on various orientations of **sapphire** is discussed based on the PL and reflectance results. The exciton binding energies were estd. in the GaN layers grown on C-, A-, and **M-plane sapphire substrates**. Polarized Raman measurements were performed on GaN layers grown on various orientations of **sapphire** and the authors obsd. quasipolar modes of both E1 and A1 symmetries. An addnl. broad photoluminescence band centered around 2.74 eV was obsd. in the GaN layers grown on R- and **M-plane sapphire substrates**. The defect induced Raman scattering in resonance with this band shows strong Raman scattering peaks resulting from the transition between energy levels of donor species or defect states.

L44 ANSWER 6 OF 6 HCAPLUS COPYRIGHT 2002 ACS
AN 1981:524528 HCAPLUS
DN 95:124528
TI Gallium nitride **epitaxy**
PA Matsushita Electric Industrial Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 3 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC C30B029-40; C30B025-18; H01L021-205
CC 75-1 (Crystallization and Crystal Structure)
Section cross-reference(s): 76
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 56059699	A2	19810523	JP 1979-134552	19791017
	JP 60026079	B4	19850621		

AB In **epitaxial** growth of GaN, a substrate (e.g., from .alpha.-Al2O3 or hexagonal SiC) with face orientation **tilted** 0.5-4.degree. (off-**angle**) with respect to the face having low indexes is used.